

# Toward a Campbellian Realist Organization Science

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## I. INTRODUCTION

For nearly four decades Don Campbell's epistemology responds to four enduring dilemmas:

1. How to build a postpositivist science that maintains the "goal of objectivity" in science (1974b) without forcing metaphysical terms out of theories and out of science in favor of operationalist observable terms?
2. How to develop a selectionist evolutionary epistemology that does not steer scientists toward Comtean positivism, instrumentalism, naïve realism, or operationalism at the expense of theory terms less detectable or more metaphysical in nature (1974b)?
3. How to build an objectivist postrelativist epistemology that incorporates the dynamics of science changing over time without abandoning the goal of objectivity (1988b)?
4. How to develop an objectivist epistemology while remaining sensitive to the differing perceptions, interpretations, and social constructions of individual scientists and scientific communities (1988b)?

Campbell's search for resolution drove him to become a "*critical, hypothetical, corrigible scientific realist*" (1988b, p. 444–445). And as he himself admitted many times and as his work suggests so clearly, he also became an *avowed evolutionary epistemologist*. Scientific realism resolved the first dilemma. Evolutionary epistemology abrogated the third one and Campbell's later conflation of evolutionary epistemology with hermeneutics nullified the fourth. In all of his writing, however, Campbell seems not have returned to the second one. One purpose of this chapter is to resolve the second dilemma.

Assuming Campbell's dilemmas are resolved and his epistemology at least preliminarily completed—realizing that no epistemology is ever finished—Campbell offers a useful message for organization science. His *Campbellian realism* provides the foundation for an objective organization science that does not deny the epistemological dynamics uncovered by historical relativists such as Hanson (1958), Kuhn (1962), and Feyerabend (1975) nor the sociology of knowledge developed by interpretists and social constructionists (Bloor 1976, Burrell and Morgan 1979, Brannigan, 1981, Shapin and Schaffer 1985, Latour and Woolgar 1986, Nickles 1989). Campbell's epistemology and the broader scientific realist and evolutionary epistemologies upon which he draws suggest that the current paradigm war between organizational positivists (Pfeffer 1982,

1993, 1995; Donaldson 1985, 1996, Bacharach 1989), and relativists (Lincoln 1985, Lincoln and Guba 1985, Reed and Hughes 1992, Perrow, 1994, Van Maanen 1995a,b, Alvesson and Deetz 1996, Burrell 1996, Chia 1996) is philosophically uninformed, archaic, and dysfunctional.

Does it matter that organization scientists are philosophically archaic? Indeed it does. Pfeffer (1993) presents data showing that multiparadigm disciplines are given low status in the broader scientific community, with a variety of negative consequences. Donaldson (1995) counts fifteen paradigms already and Prahalad and Hamel (1994) call for even more, as do Clegg, Hardy, and Nord (1996). As Campbell (1995) notes, the physical and biological sciences are held in high esteem because they hold to the goal of objectivity in science—the use of an objective external reality serves as the ultimate criterion variable for winnowing out inferior theories and paradigms. Relativist programs, on the other hand, in principle tolerate as many paradigms as there are socially constructed perspectives and interpretations. Hughes (1992, p. 297) says, "The naivety of reasoned certainties and reified objectivity, upon which organization theory built its positivist monuments to modernism, is unceremoniously jettisoned...[and] these articles of faith are unlikely to form the axioms of any rethinking or new theoretical directions...." If he is correct organization science is destined to proliferate even more paradigms and sink to even lower status—surely an unattractive outcome. Campbellian realism provides a way out of this downward spiral. A dynamic objectivist organization science that does not deny a social constructionist sociology of knowledge is possible. Surely this is a message that would delight many organization scientists.

Campbell's intense interest in scientific realism and evolutionary epistemology makes little sense absent a realization that he was well aware that philosophers had abandoned both the Received View<sup>1</sup> and historical relativism by 1970. The epitaph appeared as Suppe's *The Structure of Scientific Theories* in 1977. I begin with a painfully brief review of the essential arguments causing the abandoning. Then I turn to a discussion of some aspects of

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<sup>1</sup> Putnam (1962) refers to the combination of both logical positivism and logical empiricism as the *Received View*.

scientific realism that seem most relevant to social science, social construction of knowledge, organization science, and the realist direction Campbell takes. My next discussion shows how the conflation of current scientific realist literature and Campbell's selectionist evolutionary epistemology resolves the four dilemmas. I conclude with a statement of Campbell's message for organization scientists.

## II. THE POSITIVIST AND RELATIVIST FAILURES<sup>2</sup>

Campbell (1988b) favors an "ontological realism" emphasizing external reality as the ultimate criterion variable against which to test theories. He uses "ontological nihilism" to describe the more radical ontological relativisms following from Kuhn (1962) and Feyerabend (1975) and earlier subjectivists (Natanson 1963). Less radical, but nevertheless *ontologically weak* semantic and epistemological relativisms define numerous subjectivist programs comprising the "culture science" Perrow (1994) points to as most relevant for organization science, such as: interpretism, social constructionism, and postmodernism. Campbell's ontological realism reflects his interest in an objectivist postpositivist epistemology. His development of evolutionary epistemology reflects his continuing interest in the dynamics of how sciences change in their search for improved verisimilitude in observation and explanation without abandoning objectivist ontological realism.

Campbell's scientific realism and evolutionary epistemology developed in parallel with an emerging consensus among philosophers that positivism and relativism are flawed constructions. Campbell's dilemma is to produce a dynamic objectivist epistemology while avoiding the Charybdis of operationalism and the Scylla of an ontologically weak relativism.

### A. THE FAILURE OF POSITIVISM

...The word 'positivist', like the word 'bourgeois', has become more of a derogatory epithet than a useful descriptive concept, and consequently has been largely stripped of whatever agreed meaning it may once have had (Giddens 1974, p. ix).

In fact "positivism" has both strong and weak points and how it is defined has evolved. Positivists worry about the fundamental dilemma of science, *How to conduct truth-tests of theories, given that many of their constituent terms are unobservable and unmeasurable,*

*seemingly unreal, and thus beyond the direct first-hand sensory experience of investigators?* The term, *positivism*, was coined by August Comte. He attempted to avoid the dilemma by disallowing into science terms not directly apparent to the human senses. Comte claimed that the goal of science is prediction based only on observable terms (Audi 1995, p. 147).

Following Newtonian mechanics, German *mechanistic materialism*, held that "...existence obeys, in its origin, life, and decay, mechanical laws inherent in things themselves, discarding every kind of super-naturalism and idealism in the exploration of natural events" (Suppe 1977, p. 8, quoting Büchner 1855). It rests on empirical inquiry rather than philosophical speculation, a view in which there is no doubt that a real objective world exists. Materialism gave way to the neo-Kantian view that "science is concerned to discover the general forms of structures of sensations; the knowledge science yields of the 'external worlds' is seen as webs of logical relations which are not given, but rather exemplified...in sensory experience" (Suppe, p. 9). Thus science discovers not just the structure of matter but rather the *logic* of the interrelations among the phenomena. This view had become the dominant philosophy of the German scientific community by 1900. By mid 19<sup>th</sup> century Hegel's philosophy of "the identity of reason and reality" dominated. It proclaimed only "reason" is "real," denying the existence of tangible entities such as earth, water, and fire. The world is purely perception, a matter of the mind!

Mach added the notion that scientific statements must be *empirically verifiable*, resulting in *neopositivism*. The excesses of Mach's approach, which included a rejection of mathematics, subsequently were denied, resulting in a *modified positivism* (Whitehead and Russell 1910–1913) that still held to verifiability as a basis of assuring truth but included mathematics as an appropriate expression of scientific laws. During the ensuing decade the main elements of the *Received View* developed and were published in Carnap's (1923) first publication. It formally stated the tenets of *logical positivism*, since it included mathematical, theoretical, and observational languages as well as the separation of theory and observation terms.

By 1910 the Vienna Circle, a group of Germans trained in logic, mathematics, and physics meeting at the University of Vienna, accepted the task of considering how to respond to (1) Hegelian idealism, (2) scientists' beliefs in mechanistic materialism, (3) neo-Kantian sensory experiencing of the external world, (4) Machian neopositivism's emphasis of verification, and finally the crowning blows, (5) Planck's quantum mechanics, and (6) Einstein's theory of special relativity, both of which violated determinism, sensory relevance, and verificationism. Their official manifesto, *The Scientific World View: The Vienna*

<sup>2</sup> Lengthy histories of positivism are given by Kraft (1953), Ayer (1959), and Hanfling (1981). Kraft was a founding member of the Circle. Ayer joined circa 1933. Key sources of relativism are Hanson (1958), Kuhn (1962), and Feyerabend (1975). Suppe (1977) uses 150 pages to develop the logic underlying their abandonment. I reduce this to a few paragraphs, doing considerable injustice to the careful development of his arguments as a result. Readers questioning the arguments should take time to study Suppe's logic in its original form. There are many other critiques of course, such as Putnam (1981), Nola (1988), and Rogers (1993).

*Circle*, was published in 1929<sup>3</sup> It further defined *logical positivism*.

Responding to the philosophical dilemma, logical positivists founded their epistemology on axiomatic theories, using terms comprising three languages: “(1) logical and mathematical terms; (2) theoretical terms; and (3) observation terms” (Suppe 1977, p. 12). Theory terms are unreal, abbreviated representations of phenomena described by the observation terms. *Correspondence rules* (C-rules) assure theoretical terms are explicitly linked to observation terms. They held that theory terms are unreal and, thus, theoretical explanations of causality are also unreal, leading to the view that theories may be interpreted only as *instrumental summaries* of empirical results (Boyd 1991, Hunt 1991, p. 276–277). The “scientific truth” in theory terms is ascertained via verification in observation terms. Logical positivists attempted to clarify the language of science by expunging metaphysical terms not amenable to direct sensory testing and by insisting that logic terms be verified as to cognitive meaning and truth, thereby “ridding it [science] of meaningless assertions by means of the verifiability principle and reconstructing it through formal logic into a precise, ideal language” (Hunt 1991, p. 271).

In his classic statement Schlick (1932/33)<sup>4</sup> focused on the seeming impossibility of ever knowing whether the external world is different from the metaphysical or transcendent reality of the human senses, that is, cognitive construction or interpretation. In his view the only way to tell if some datum is real or not is to take it away and see if there is a difference. Thus, if I sit once and the chair is there and if I sit again and the chair is not there and I fall, I may conclude the chair is real. This is what Schlick refers to as a *testable difference*.

Subsequently Braithwaite (1953), Nagel (1956, 1961), and Hempel (1965), evolved an epistemology focusing on *laws*, *explanation*, and *theory*, known as *logical empiricism*.<sup>5</sup> It replaced logical positivism by mid 20<sup>th</sup> century. The logical empiricists’ immediately encountered a problem with the verifiability principle, since for a law to be verified it must be empirically proved universally true for all times at all places, an impossibility. Consequently verifiability was abandoned, to be replaced by a somewhat relaxed *testability criterion* that all propositions have to be

amenable to some measure of empirical test, a view eventually championed by Popper (1959) as his *falsifiability principle*. This modification finally admitted that theory terms could never be directly “verified” empirically.

In responding to the fundamental dilemma, the logical empiricists attempted to deal with the problems identified with the logical positivists’ strict separation of theory and observation terms via the use of C-rules. How to have an “unreal” theory term explicitly defined via C-rules without having the theory term simply be the result of an observable measure of some sort? This would become an *operationalist’s* treatment of theory—it is whatever is measured (Hempel 1954). It created the “theoreticians dilemma:” (1) *If all theory terms can be explicitly defined by reduction to observation terms, then theory terms are unnecessary*; and (2) *If theory terms cannot be explicitly defined and related to observation terms they are surely unnecessary because they are meaningless* (Hempel, 1965, p. 186). Further, if theory terms are isomorphic to operational measures there is no possibility of using the theory to predict new phenomena, as yet unmeasured.

It is clear that the term “positivism” is now obsolete among modern philosophers of science (Rescher 1970, 1987; Devitt 1984, Nola 1988, Suppe 1989, Hunt 1991, de Regt 1994, Aronson, Harré, and Way 1994). Nevertheless, many key ingredients of positivism still remain in good standing among scientific realists, such as: theory terms, observation terms, tangible observables and unobservables, intangible and metaphysical terms, auxiliary hypotheses, causal explanation, empirical reality, testability, incremental corroboration and falsification, and generalizable law-like statements—as shown in Table 1. The various positivisms are *ontologically strong*, in the sense that they posit an external reality and that successive scientific discoveries and theories over time more and more correctly describe and explain this reality—reality acts as a strong external criterion variable against which scientific theories are held accountable.

>>> Insert Table 1 about here <<<

## B. RELATIVISM

Many scholars interpret historical relativism as antithetical to positivism. Thus, “[historical relativism] made scientific knowledge a social phenomenon in which science became a subjective and, to varying degrees, an irrational enterprise” (Suppe, 1977: 705). Nola (1988) separates relativism into three kinds:

1. “Ontological relativism is the view that what exists, whether it be ordinary objects, facts, the entities postulated in science, etc., exists only relative to some relativizer, whether that be a person, a theory or whatever” (1988, p. 11)—[*ontologically nihilistic*].
2. Epistemological relativisms may allege that (1) what is known or believed is relativized to individuals, cultures, or frameworks; (2) what is perceived is relative to some incommensurable paradigm; (3) there is no general theory of scientific method, form of inquiry, rules of reasoning or evidence that has privileged status. Instead they are variable with respect to times, persons, cultures, and frameworks (1988, pp. 16–18)—[*ontologically very weak*].
3. Semantic relativism holds that truth and falsity are “...relativizable to a host of items from individuals to cultures and frameworks.

<sup>3</sup> Originally: O. Neurath, with R. Carnap and H. Hahn, *Wissenschaftliche Weltauffassung, Der Wiener Kreis*, Wien, Artur Wolf, 1929. [A pamphlet reprinted and translated in M. Neurath and R. S. Cohen (Eds.), *Empiricism and Sociology*, Dordrecht, The Netherlands: Reidel, 1973, pp. 301–318.]

<sup>4</sup> The paper is reprinted in Boyd, Gasper, and Trout as “Positivism and Realism” (1991, pp. 37–55).

<sup>5</sup> Logical empiricism was a label preferred by some members of the Vienna Circle very early on, specifically, Morris (1935), Carnap (1936–1937), Schlick (1938).

What is relativized is variously sentences, statements, judgements or beliefs” (1988, p. 14)—[*ontologically weak*].

Nola observes that Hanson, Kuhn and Feyerabend espouse both semantic and epistemological relativism. Relativisms<sup>6</sup> familiar to organization science range across all three kinds, that is, from ontological nihilism to ontological weakness. Campbell clearly considers himself a semantic relativist in addition to being an ontological realist (Campbell and Paller 1989).

It is important to recognize (1) that historical relativism does put science in motion, as it were, shifting philosophical thinking from the static Received View to the dynamics of how scientific communities shift from one *Weltanschauung* (world view) to another; and (2) that relativism is *ontologically weak* in the sense that perceptions, interpretations and social constructions, or epistemologies diminish the strength of external reality to act as an external criterion variable guiding truth-testing, and therefore seemingly antithetical to Campbell’s ontological realism. Even so, in the last decade of his writing Campbell folded some of the nondynamic aspects of relativism into his brand of realism. Consequently it is important to discriminate between elements of relativism remaining in good standing and strands that have been abandoned. By Suppe’s (1977) analysis key historical relativists are Toulmin (1953, 1961), Bohm (1957), Hanson (1958), Kuhn (1962, 1970, 1977), and Feyerabend (1962, 1979, 1975). Since Toulmin sets the stage and Kuhn has been the most influential on organizational scientists, I outline their main ideas, followed by a brief critique.

**Toulmin** notes that a regularity such as “light travels in a straight line,” is an “ideal of natural order,” that does not need explanation. If light bends, however, this is an irregularity needing explanation—hence the search for a law. Theories are to explain, not necessarily to predict. Toulmin claims theories are neither true nor false. They are simply representations of phenomena that may be more or less fruitful in allowing a theorist to answer questions about irregularities. “Scientific theories thus are formulated, judged, maintained, and developed relative to a *Weltanschauung* which includes the changed meanings attached to terms after they undergo a language shift resulting from their incorporation into the theory, ideals of natural order, and presumptions which determine what are counted as significant facts, what questions the scientist asks, the assumptions which underlie his theorizing, and the standards by which he assesses the fruitfulness of the theory. This

<sup>6</sup> The category, “strong forms of relativism” also includes other ontologically weak subjectivist *postpositivisms* such as ethnomethodologists, historicists, radical humanists, phenomenologists, semioticists, literary explicationists, hermeneuticists, and critical theorists, all of which are “post” positivist and in which subjective and cultural forces dominate ontological reality. Lincoln and Guba (1985, p. 7) use the term “*naturalism*” to encompass a similar set of postpositivist paradigms.

*Weltanschauung* is dynamically evolving, and may change as the theory undergoes development” (Suppe 1977, p. 132). That the *Weltanschauung* may evolve in interaction with developing theories is what gives relativism its dynamic character and is what clearly sets it apart from the Received View, which holds that theories evolve from formalized axiomatic reduction—which is necessarily static (Suppe 1977, p. 114).

**Kuhn** is surely the most influential relativist. Following Toulmin, Kuhn builds on the idea of *Weltanschauungen*, which both see as dynamically evolving. The fundamental difference is that in Toulmin’s framework the *Weltanschauung* changes incrementally in a gradualist fashion, whereas in Kuhn’s view *Weltanschauung* dynamics consist of long periods of relative stability, termed *normal science*, broken intermittently by *paradigm shifts*. “Paradigm” is Kuhn’s term for *Weltanschauung*. Unfortunately, as Masterman (1970) points out, “paradigm” has some 21 different meanings in Kuhn’s 1962 book. Shapere (1964, p. 385) complains, “In short, anything that allows science to accomplish anything can be a part of (or somehow involved in) a paradigm.” Hence Kuhn (1977) substitutes a more narrowly defined “*disciplinary matrix*” for paradigm.

In Kuhn’s view science evolves through long periods of convergent “normal puzzle” solving activities punctuated infrequently by paradigm shifts. Normal science is carried out by scientists sharing a common “disciplinary matrix,” acquired through apprenticeship. The matrix defines the shared exemplars of good scientific activity, core values, and methods. The matrix constitutes the *Weltanschauung*. Communities with different exemplars and different conceptual perspectives see the world and conduct their science differently. Consequently there is no “neutral” observation language and incommensurability results, preventing members of one *Weltanschauung* from being able to communicate with and evaluate the work of those following a different paradigm. Eventually an accumulation of anomalies causes a paradigm shift.

As Suppe (1977) notes, complaints against Kuhn’s framework are legion: (1) The problem of the twenty-one definitions of the term, paradigm, has already been noted; (2) Many disagree that a correct reading of scientific history offers any indication of disjunctive shifts between normal puzzle solving and revolution; (3) Others complain that under Kuhn’s framework science becomes irrational and subjective, leaving it with no objective or independent basis of resolving disputes—“an anti-empirical idealism” (Suppe 1977, p. 151); and (4) Meanings of terms may not in fact change just because disciplinary matrixes shift.

**Critique.** Suppe elaborates four specific arguments against relativism.<sup>7</sup>

<sup>7</sup> Space precludes expanding the critique beyond the basic objections outlined by Suppe, to include Natanson 1963, Ravitz 1971, Stockman 1983, Taylor 1985, Nola 1988, Munévar 1991, and Masters 1993, among others.

1. *Objectivity.* The strong form of relativism (ontological nihilism)—that objects, facts, and properties are colored by the nature of the theory held by an observer—is rejected by Scheffler (1967) as being no different than Hegelian idealism in which all objects in the world are perceptions and “in the mind.” Suppe notes, however, that Toulmin, Hanson, Kuhn, Feyerabend, and Bohm all accept a weaker form—that objects, facts, and properties, as they exist, are independent of an observer but that the nature of objects, facts, and properties thought to be observed by an individual might indeed be determined by the influence of the *Weltanschauung*.<sup>8</sup> The weak form also fails, however, because *Weltanschauungen* do not exist for reasons of history, meaning-variance, and uniformity.

2. *Historical Accuracy.* Toulmin’s view that *Weltanschauungen* changed gradually with the accumulation of ideals of natural order, theories, and laws, appears more accurate than Kuhn’s view that normal science is punctuated by occasional revolutions, caused by a crisis of anomalies. Hull (1975, p. 397) says, “The periods which he [Kuhn] had previously described as pre-paradigm contained paradigms not that different from those of normal science.... [N]or does normal science alternate with revolutionary science; both are taking place all the time. Sometimes a revolution occurs without any preceding state of crisis.” Laudan (1977, pp. 74, 151) concludes, “...[V]irtually every major period in the history of science is characterized both by the co-existence of numerous competing paradigms, with none exerting hegemony over the field, and by the persistent and continuous manner in which the foundational assumptions of every paradigm are debated within the scientific community.... Kuhn can point to no major science in which paradigm monopoly has been the rule, nor in which foundational debate has been absent” (quotes from Hunt, 1991, p. 326).

3. *Meaning-Variance.* One of the claims of the historical relativists is that as a field shifts from one *Weltanschauung* to another the meanings of all of the underlying theory terms also change. The implication of this is that there are consequently no common terms to use in making comparative evaluations of the different *Weltanschauungen* as to truth. Suppe (1977, p. 199–208) first shows that the strong form preferred by Feyerabend and Bohm—that “any change in theory alters the meanings of all the terms in the theory”—is untenable. He observes that no historical relativist has established that *any* change, even a major one, in any theory changes all the terms.

Suppe then argues why a weaker form preferred by Toulmin, Kuhn, and Hanson—that “meanings of terms in theories are determined partially by the principles of the theory”—is also untenable and undermines as well

the conclusion that *Weltanschauungen* are incommensurable. **First**, it is untenable because theories are constantly reformulated to generate propositions fitting particular empirical circumstances for deductive tests. If such reformulations are taken as substantive changes in a theory, with constituent terms all changing as well, then a general theory that might apply to more than one phenomena, such as gravitational force applied to bending light rays, falling bodies, or orbital mechanics, would constitute changes in the meanings of terms and thus would presume every application of the gravity force constitutes a new *Weltanschauung*, which seems ridiculous on its face. **Second**, once it is agreed that only *some* elements of a theory might change and thus only *some* terms might change meaning, the opposite is true, that *some* terms will *not* change in meaning, suggesting that the *Weltanschauungen* are not incommensurable—common terms may allow comparative analyses.<sup>9</sup> **Third**, theories are not simply “linguistic formulations” in the sense that they change just because terms, as linguistic entities change. Theories are not thought to change if translated from English to French. Suppe extends this argument to include what appear to be “translations” within one language, as a scientific community moves from, say, Newtonian theory to Einsteinian theory. Thus, even though the linguistic structure of a theory might change, the meanings of many of its terms might not change at all, leaving the theories semantically commensurable though seemingly linguistically incommensurable.

The availability of many cross-paradigm terms is illustrated in the *Handbook of Organization Studies* (Clegg, Hardy, and Nord 1996). It contains chapters falling into the positivist, interpretist, and postmodernist disciplinary matrices. Yet the obvious presumption of the editors is that

<sup>9</sup> To pick an example, consider the most famous so-called paradigm shift, that from Newton to Einstein. In his 1905 paper Einstein drew mainly on the work of Faraday 70 years earlier. The reason he cited Faraday was that he defined the problem as how to specify a theory of relative motion for the electrodynamics of moving bodies parallel to the already existing theory of relative motion in Newtonian mechanics. By 1895 both Poincaré and H. A. Lorentz had announced principles of relativity but to balance the equation governing the relative motion of two inertial systems they retained the concept, ether. In contrast, since the speed of light was discovered to remain constant (Einstein, unaware of the discovery, assumed it as a principle), Einstein accommodated relativity by allowing time to change. Thus, in the Lorentz transformation equations,  $t' = t$  became  $t' = (t - vx/c^2) / (1 - v^2/c^2)^{1/2}$ . Note that none of the terms on the right side of the equation changed meaning, only the term  $t'$  changed. What is important to note is that there would have been no reason for Einstein to do what he did if the other terms had not remained unchanged—a clear violation of incommensurability. The significance of relativity theory is that none of the terms changed meaning except time. In addition, the new idea appeared in a journal article in an obscure Einstein’s first year of publication after his doctorate. How on earth could referees in the old paradigm accept for publication an article by an unknown author in a different supposedly incommensurable paradigm? This only makes sense if relativity was in fact not incommensurable with existing “Newtonian” thinking. See Holton (1988) for the full range of views on whether or not relativity theory was incommensurable with Maxwell, Poincaré, and Lorentz.

<sup>8</sup> Suppe’s characterization is confirmed by Nola (1988).

the terms used in each chapter share meaning across matrices—otherwise the editors are in the awkward position of having “edited” a book much of which they do not understand.

4. *Weltanschauung Uniformity*. A *Weltanschauung* is typically a complex framework supposedly emerging from the collective beliefs of a scientific community. These beliefs are the result of years of training, exemplars such as textbooks, apprenticeships, research programs, and journal articles, and of course are composed of all the relevant theory language of principles and terms, various theory formulations, experimental methods, and so on—truly a complex multifaceted belief-system. Suppose that each individual is somewhat different by virtue of being trained at different places, apprenticing to different mentors, and studying different books and articles. If the individuals are somewhat different, it seems unlikely that a uniform *Weltanschauung* would emerge. And, inasmuch as a *Weltanschauung* belief system is complex, it is unlikely that a paradigm shift from one paradigm to another would necessarily involve all elements of a complex belief system. Thus for any given paradigm shift, some number of beliefs, theories, terms, and definitions would remain unchanged among some number of *Weltanschauung* members, thus undermining incommensurability.

Suppe (1977, pp. 217–221), concludes: 1) historical relativists deserve credit for alerting us to the dynamics of how science progresses; and 2) the idea that scientific communities are possessed of incommensurable *Weltanschauungen* is false. It follows that the “different province” idea mentioned by Perrow (1994) has been rejected by philosophers. Consequently, the *Weltanschauung* approach is not only not a contender as an accepted epistemology, it also cannot be used to debunk the tenets Suppe concludes still remain intact from the Received View. Thus there is reason to reject the view that organizations and organization science are somehow limited to a “culture science” that is incommensurable with what remains of the Received View.

### III. SCIENTIFIC REALISM

Though positivism failed the problem remains, How to conduct truth-testing given a mixture of metaphysical and observable terms while also avoiding naïve realism or operationalism? Though the disjunctive paradigm shift and incommensurability aspects of relativism failed the question remains, How to deal with changing science and how to produce an objectivist epistemology given the influence of socially constructed and thus totally metaphysical or idealist scientific conceptions of phenomena? Campbell’s solution is to combine scientific realism, evolutionary epistemology, and hermeneutics. Though Campbell’s epistemology depends on scientific realism, I believe it is fair to conclude that his scholarly roots in the scientific realist

literature are not as well delineated as one might like—the best being Paller and Campbell (1989). The credibility of Campbell’s message would strengthen, I believe, if the connection was further elucidated. Consequently in this Section I review a few critical scientific realist developments directly supporting his approach.

Scientific realists adhere to the premise “that the long term success of a scientific theory gives reason to believe that something like the entities and structure postulated by the theory actually exists” (McMullin 1984, p. 26)—a statement that is still considered at the heart of scientific realism (Hunt 1991, de Regt 1994). Philosophers’ fundamental concerns over how best to ascertain the truth of scientific theories have truly metamorphosed from the Received View, past the postpositivist teachings of Hanson, Kuhn, and Feyerabend, and on into scientific realism. In fact there is currently a vigorous discourse about scientific realism, little of which appears to have penetrated into organization science. This despite the fact that scientific realism is the most widely accepted reconstructed logic among current philosophers of science (Boyd 1991, Aronson, Harré, and Way 1994, de Regt 1994, Wright 1997).<sup>10</sup>

Before 1980 scientific realism was typically a *convergent epistemological realism*, holding that

- (1) “mature” scientific theories are approximately true; (2) the concepts in these theories genuinely refer [to empirical phenomena]; (3) successive theories in a domain will retain the ontology of their predecessors; (4) truly referential theories will be “successful,” and, conversely, (5) “successful” theories will contain central terms that refer. (Anderson 1988, p. 403; based on Laudan 1981; also cited in Hunt 1991, p. 390)

Boyd (1983) also advocates the approximationist or convergent approach in his description of scientific realism—shown in Table 2. The approximationist view was convincingly debunked by Laudan in a widely cited paper (1981). He accused 1970s realists of depending too naïvely on a process of convergence toward theories thought to have higher truth value. He said this is nothing other than the notorious “fallacy of affirming the consequent.” To say the theory, “the sun goes around the earth” is true because I see the sun rise every morning is an example of this fallacy. Some details of Laudan’s logic are presented in Table 3.

>>> Insert Tables 2 & 3 about here <<<

Scientific realism’s early aura of accomplishment during the 1970s was ended by another key anti-realist event—the publishing of van Fraassen’s very influential book *The Scientific Image*, in 1980 (Derksen 1994). Van Fraassen develops a strong argument for his anti-realist *constructive empiricism*, key elements of which are listed in Table 4. In

<sup>10</sup> For additional evidence of support see: Popper, 1956/1982, Sellars 1963, Maxwell 1962, 1970; McMullin 1970, 1978; Hesse 1963, 1974; Smart 1963, Shapere 1969, Harré 1970, 1986, 1994; Boyd 1973, 1989, 1992; MacKinnon 1979, Putnam 1982, 1987, 1990, 1993; Devitt 1984, Leplin 1984, 1986, Churchland and Hooker 1985, Hooker 1987, Rescher 1987, Nola 1988, Suppe, 1989, Hunt, 1991, Dummett 1992, Blackburn 1993, Derksen 1994.

a penetrating critique he debunked the root premise of the realists, that theory terms other than those directly observable could be truth-tested and considered both real and true, as being unnecessary. In his view a theory may become successful, be adopted, and believed in as empirically adequate without one having to take the additional step of believing it is true and its terms real.

>>> **Insert Table 4 about here** <<<

Paller and Campbell (1989) define their “*hypothetical realism*” to counter both these attacks, arguing that “...evolutionary epistemology argues against it [epistemological realism], as against naïve, direct, and clairvoyant realisms” (p. 121). First they connect hypothetical realism to Popper’s (1959) *epistemologically fallibilist realism* and Popper’s slogan, “we do not know; we can only guess” (p. 278)—which Popper later called *metaphysical realism*. Next they connect hypothetical realism to Polanyi’s (1958) “hidden reality” by drawing on his argument “...that the data do not compel belief in scientific theories and entities...and...that the duty of...scientists is to strive for theories that describe that reality” (Paller and Campbell 1989, p. 120). Most importantly they then connect hypothetical realism to Bhaskar’s (1975/1997) “*transcendental realism*.” Finally they claim that Laudan accepts their view as outside the range of his critique.

**Bhaskar’s Transcendental Realism.** I have three specific reasons for starting with Bhaskar: (1) The main themes of Bhaskar seem to have survived the van Fraassen attack and remain central to the most recent development by Harré (Aronson, Harré and Way 1994), one of the earliest tillers of the scientific realism field (Harré 1961, 1970); (2) Bhaskar is particularly important to organization scientists because his realism includes elements of neoKantian transcendental idealism and the social construction of science. He says, “epistemological relativism in this sense [that scientific progress depends on social constructions] is the handmaiden of ontological realism and must be accepted” (1975/1995, p. 249). The Kuhnian developmental paradigm is central to his conception of scientific realism (p. 193); and (3) Paller and Campbell (1989, p. 120) note that Bhaskar’s transcendental realism fits with Campbell’s critical hypothetical realism. Campbell places himself centrally between the ontologically strong and weak camps, saying “I am an epistemological relativist, but I am not an ontological nihilist” (1988b, p. 447). The record is clear that Campbell draws about equally from realism (1989a, 1990a, Paller and Campbell 1989) and relativism (1989b, 1991, 1995), in pursuing his selectionist epistemology. In light of this, I briefly outline Bhaskar’s argument, taking it to be a combined realist/relativist approach particularly well suited for organization science.

“...[T]here is in science a characteristic kind of dialectic in which a regularity is identified, a plausible

explanation for it is invented and the reality of the entities and processes postulated in the explanation is then checked” (Bhaskar 1975/1997, p. 145). This logic of scientific discovery is diagrammed in Figure 1. The quote describes Comtean positivism, what Bhaskar terms *classical empiricism*, in which intangible and unmeasurable terms are avoided in favor of observable instrumental relations between factual events. In this view science is reduced to “...facts and their conjunctions. Thus science becomes a kind of epiphenomenon of nature” (p. 25). Bhaskar says that classical empiricist epistemology holds for closed systems but falls apart in open systems where the many uncontrolled influences minimize the likelihood of an unequivocal determination of a counterfactual such as “If *A* then *B*.” “...[I]t is only if I have grounds for supposing that the system in which the mechanism acts is closed that the prediction of the consequent event is deductively justified” (p. 103).

>>> **Insert Figure 1 about here** <<<

In stage 1 of Figure 1 Bhaskar makes a clear distinction between developing theory based on identified *regularities*—which could be accidental—and experimentally contrived *invariances* in which repeated experiments produce an outcome regularity by manipulating what is hypothesized to be an underlying force, process, mechanism, or structure. Contrived invariances better fit the counterfactual conditional basis of law-like statements about generative forces that might seldom if ever be discernible naturally in complex open systems (like organizations) because of the many countervailing influences. Bhaskar then notes that both stages 2 and 3 lead to the development of conceptual representations of posited underlying generative forces such as structures and processes in the form of iconic<sup>11</sup> or formal (mathematical or computational) models.

Initially, the mental models of *transcendental idealists* and *transcendental realists* both contain “*imagined*” (Bhaskar’s term, p. 145) conceptual, intangible, unmeasurable theory terms. The difference is that for idealists they remain forever intangible, interpreted, socially constructed, metaphysical, and *unreal*, whereas for realists the better detection of theoretical terms, repeated experiments, and other kinds of empirical research that are requirements for moving from stage 2 to stage 3 eventually give cause to believe that what were initially imagined metaphysical terms and entities become *real*. Thus, transcendental idealists, reflecting Hegelian and neoKantian idealism, historical relativism (Hanson 1958, Kuhn 1962, Feyerabend 1975), and interpretive social construction (Brannigan 1981, Taylor 1985, Munévar 1991, Masters 1993), see models as artificial constructs.

Bhaskar notes, however, that though models may be independent of particular scholars, they are not independent

<sup>11</sup> An iconic model is one that offers a visual image such as “boxes and arrows,” balls and sticks (for atoms), or a mechanical representation.

of human activity in general. The natural world becomes a construction of the human mind and of a scientific community (pp. 27, 148–167). He says:

Transcendental realists regard "...objects of knowledge [in the models] as the structures and mechanisms that generate phenomena; and the knowledge as produced in the social activity of science. These objects are neither phenomena (empiricism) nor human constructs imposed upon the phenomena (idealism), but real structures which endure and operate independently of our knowledge, our experience and the conditions which allow us access to them. Against empiricism the objects of knowledge are structures, not events; against idealism, they are intransitive.... (p. 25)

Bhaskar (p. 25) takes an "updated dynamized" version of Kant's famous *transcendental argument* that reason and experience presume a priori objectively valid phenomena (Audi 1995, p. 808). "...[I]ntransitive objects of knowledge are in general invariant to our knowledge of them: they are the real things and structures, mechanisms and processes, events and possibilities of the world...." (p. 22). *Intransitive* means that objects of scientific discovery exist independently of human perceptions, interpretations, and social constructions, and by *structured* Bhaskar means they are "...distinct from the patterns of events that occur" (p. 35). Further elaborated, structures are underlying forces that may occur independent of observed regularities and may not be observable or measurable except via contrived experiments and the creation of invariances.

Bhaskar's diagram offers a choice between two flow conceptions. "**Regularity**" flow begins at stage 1 with Comtean positivism where science is limited to stating relations among intransitive measurable empirical *Realm 1*<sup>12</sup> regularities. Next comes stage 2 and the recognition that science includes *Realm 3* theory terms representing underlying causes, which relativists now take as transitive idealistic conceptions that are unreal and unique to observers or perhaps scientific communities. Finally comes stage 3 with the recognition that science includes *Realm 3* conceptions that are real in that they do indeed represent intransitive natural underlying causal forces. "**Invariance**" flow, the preferred view, starts with the bifurcation between experimentally contrived invariances and identified event regularities. Terms in models purporting to represent the underlying natural causal forces reflect *simultaneously* both stage 2—cognitive (idealistic) concepts of underlying mechanisms that are transitive, reflecting the idea of science as a "process-in-motion" (Bhaskar, p. 146), and stage 3—approximations of intransitive real underlying forces. In

the invariance flow view, four fundamental aspects of science are highlighted: (1) creation of counterfactual experimental invariances; (2) creation of iconic or formal models containing at least some *Realm 3* terms representing underlying causal mechanisms; (3) recognition that science consists of process-in-motion that creates transitive theory terms; and (4) recognition that scientific realism is based on theory terms that are successively improved approximations of intransitive real underlying causal mechanisms.

**Fallibilist Realism.** Bhaskar's analysis shows that scientific realism describes a process in which theoretical terms and entities initially imagined, interpreted, or socially constructed are eventually held accountable for truth content with respect to an objective reality via experiments and other kinds of empirical research. Bhaskar clearly supports Campbell's conflation of realism and relativism. Remaining to be supported is Campbell's "fallibilist realism." This calls for further analysis of the nature of truth-testing and further delineation of the relation between truth-testing and the *Realms of terms*.

The *convergent realist*, Giere (1985), accepts the model-centeredness of van Fraassen's proposed epistemology,<sup>13</sup> but he distinguishes between observability (*Realm 1*) and detectability (*Realm 2*). Van Fraassen accepts detection if humans could get repositioned so the detection instrument was unnecessary—thus the moons of Jupiter are observable, though from earth they are detectable only with an instrument, whereas quarks can never be observed by humans. This puts the basis of belief on human capabilities—we can travel to the stars but cannot shrink down to see quarks. Should the basis of truth rest on human physiology or travel capabilities? No. Giere and others (Churchland 1979, Shapere 1982) accept belief based on detection, and by adding experimental manipulation we may include Hacking (1983) and Harré (1986). Devitt (1991) suggests that van Fraassen's argument provides the grounds for its own defeat, as follows: The arguments van Fraassen makes to support constructive empiricism, which are (1) research findings give information about *Realm 1* objects; and (2) research findings give information about unobserved observables via detection (*Realm 2*), defeat his thesis that research experience does not give information about unobservables. De Regt says, "Since van Fraassen admits that the gathered information about *Realm 1* and *Realm 2* entities is uncertain, the embarrassing question arises why experience cannot, in a risky way, inform us about unobservables" (1994, p. 110).

Devitt (1984, p. 128) concludes that even van Fraassen would surely have to accept a "*Weak Form of Scientific Realism*." Supposing, for example, we view only human footprints in the sand (no person in sight), the weak form holds that some unobservable entity *X* made the footprints and therefore we have the right to believe in the truth of a

<sup>12</sup> As my discussion proceeds it will be convenient to use Harré's (1989) labels for kind of terms or entities: *Realm 1* entities are currently observable [number of employees in a firm]; *Realm 2* entities are currently unobservable but potentially detectable [process event networks in a firm]; and *Realm 3* (metaphysical) entities are beyond any possibility of observation by any conception of current science [psychological need, environmental uncertainty, underlying cause]. Note that they are not the same as Bhaskar's three stages.

<sup>13</sup> My analysis of the Giere and Devitt critique closely follows that given by de Regt (1994, pp. 107–113).

theory using  $X$ —as real—to explain the footprints, but we have no right to believe that a human being made them—it could have been a robot. Derksen (1994) also argues that this form can be defended because one can have epistemic reasons for believing in unobservables as real (something unreal cannot make real footprints) even though we cannot make the stronger claim that a specific kind of  $X$  actually exists. Thus, “we can have reasons for believing that a theoretical entity  $X$  [i.e. an unobservable] is an—acceptable—candidate for reality, worthy to be taken seriously” (p. 23).

De Regt’s (1994, pp. 279–280) “*Negative Argument for Scientific Realism*” is as follows:

1. Many scientific beliefs are based on epistemologically founded rationality, that is, scientists do not have beliefs about the world that are not based on some argument.
2. By insisting on only empirical adequacy van Fraassen denies the existence of epistemic rationality.
3. Scientists are not prepared to give up on all rational scientific beliefs.
4. Thus, van Fraassen’s constructive empiricism is implausible.
5. Therefore scientific realism gains plausibility.

Possibly the negative argument is not any stronger than the weak argument. De Regt ends his book with a “*Strong Argument for Scientific Realism*,” as paraphrased in Table 5. In de Regt’s flow of science, incremental inductions systematically reduce belief in the less truthlike theories in favor of those having high verisimilitude (truthlikeness). Successful theories, defined as those that are instrumentally reliable, therefore incorporate higher verisimilitude. The likelihood of underdetermined and thus potentially false theories remaining, which include Realm 3 terms, is minimal. At any given time the inductive process leads to *probable* knowledge about Realm 3 terms, which warrants *tentative* belief in the existence of the Realm 3 terms—putting scientific realism on a more plausible foundation than van Fraassen’s constructive empiricism. De Regt’s “strong argument” is clearly a *fallibilist realism*—note how many times “probability” appears.

>>> **Insert Table 5 about here** <<<

The meaning of plausibility and verisimilitude is fleshed out by Aronson, Harré, and Way (AHW) (1994). Building on van Fraassen’s model-centered conception of science, they develop their *plausibility thesis*, key tenets of which are shown in Table 6. As does Bhaskar (1975/1997, Ch. 1), AHW argue that plausibility stems from both the experimental<sup>14</sup> and the ontological adequacy of a model. Verisimilitude and plausibility increase as a function of both (1) improved experimental

adequacy of a model to predict or retrodict; and (2) improved ontological adequacy of a model to represent (refer to) phenomena defined as within the scope of a theory. Scientific progress is based on the increasingly close relationship between accurate representation of reality, on the one hand, and prediction and measurement on the other. Thus, Figure 2, reproduced from AHW (p. 197), shows the relation between (1) scientific progress defined as better predictions and manipulations (*experimental adequacy*)—defined as predictions suggested by a theory  $P$  compared to experimentally created invariances (results)  $B$ ; and (2) making the model more representative (*ontological adequacy*)—defined as a model’s representation of phenomenon  $T$  compared to what the phenomenon is like in reality  $A$ . It shows two possible dynamics. First, the dotted line toward the origin shows progress in the *quest for increased truth* as a function of both experimental and ontological adequacy. Second, the *veil of perception* depicting the level of observability of the terms comprising the theory may move from Realm 3 to Realm 1 independently of where the dotted line “level of truth” is. AHW then state their *principle of epistemic invariance*, which holds that “*the epistemological situation remains the same for observables and unobservables alike*,” whether the state of observability is in Realms 1, 2 or 3 (1994, p. 194).

>>> **Insert Table 6 and Figure 2 about here** <<<

Though van Fraassen (1980) challenges scientific realism, his model-centered view of science (confirmed as the semantic conception by Beth 1961, Suppes 1962, Suppe 1989, Lloyd 1988, Thompson 1989), underlies de Regt’s, and AHW’s support of Campbell’s hypothetical realism. First, Bhaskar sets up the model development process in terms of experimentally manipulated invariances—as opposed to observed regularities. He differentiates between (1) the creation of a transcendental idealist model as an incrementally improved socially constructed representation of a transitive reality—based on individually interpreted, socially constructed, and imagined knowledge of reality; and (2) the creation of a transcendental realist iconic or formal model, which progressively more accurately and successfully (in terms of accuracy of predictions), represents intransitive reality. Second, Van Fraassen, develops a model-centered epistemology and sets up experimental adequacy as the only reasonable and relevant truthlikeness criterion. Third, accepting the model-centered view and experimental adequacy, AHW add ontological adequacy so as to create a scientific realist epistemology. In their view, models are judged as having a higher probability of truthlikeness if they are experimentally adequate in terms of a theory leading to predictions testing out experimentally, and ontologically adequate if terms of the model’s structures accurately represent that portion of reality deemed within the scope of the theory. In recognizing the fundamental differentiation between experimental and ontological adequacy AHW mirror Bhaskar’s move away from an epistemic driven ontology to an ontology viewed independently of epistemology. They also set up the independence between movement toward improved

<sup>14</sup> I have substituted *experimental* in place of van Fraassen’s *empirical* adequacy. As made clear by Bhaskar, philosophers prefer experimental empirical methods and nomic necessity so as to avoid accidental regularities. This fits closely with the label, “Better predictions and manipulation,” that AHW use in their Figure 9.1 (Figure 2 here). This also avoids confusion with *ontological* adequacy which is also an empirical test of how well model structures represent the real world.

truthlikeness and the designation of whether the terms are Realm 3 or Realm 1.

Finally, de Regt develops a “strong argument” for scientific realism building on the probabilist paradigm, recognizing that instrumentally reliable theories leading to highly probable knowledge consist of a *succession of eliminative inductions*<sup>15</sup> that reduce the probability of underdetermination to negligible proportions. This supports the idea that instrumentally reliable inductive arguments based on observables leads to similar quality arguments based on unobservables, thus agreeing with AHW’s view of the independence of (1) movement toward truthlikeness and (2) movement from Realm 1 to Realm 3 terms or entities. Hence the realist view that at any given time, one is “epistemologically warranted to tentatively believe in the existence of the specified unobservables” (de Regt, p. 284; his italics). As defined here, the new convergent realism is more plausible than van Fraassen’s constructive empiricism, since the latter insists that scientists abandon scientifically rational beliefs pertaining to the tentative reality of terms included in theories shown over time to be instrumentally reliable in producing highly probable knowledge about Realm 3 entities (terms) in the context of constant movement from Realm 1 to Realm 3.

Boyd (1983) concludes, and reaffirms in 1991, that scientific realism offers the only explanation for the instrumental reliability of the scientific method that itself meets the standards of scientific soundness (1991, p. 14).<sup>16</sup> The new inductively plausible convergent scientific realism also solidly supports Campbell’s hypothetical realism. How the “convergent” part actually works, over time, to produce theories having a higher probability of truth is the subject of selectionist evolutionary epistemology, a subject in which Campbell was without peer.

#### IV. EVOLUTIONARY EPISTEMOLOGY

Campbell (1974b) credits Popper for introducing and developing a Darwinian selectionist evolutionary epistemology.<sup>17</sup> Popper’s thoughts on this subject are

mainly collected in his book, *Conjectures and Refutations* (1963), though his earliest writing on the subject dates back to 1934. In a later book, *Objective Knowledge: An Evolutionary Approach*, Popper states:

...[T]he growth of our knowledge is the result of a process closely resembling what Darwin called ‘natural selection’; that is, *the natural selection of hypotheses*; our knowledge consists, at every moment, of those hypotheses which have shown their (comparative) fitness by surviving so far in their struggle for existence; a competitive struggle which eliminates those hypotheses which are unfit.... From the amoeba to Einstein, the growth of knowledge is always the same: we try to solve our problems, and to obtain, by a process of elimination, something approaching adequacy in our tentative solutions. (1972, p. 261; his italics)

During the twenty-five years following Campbell’s 1974b paper a considerable literature has emerged, including some twenty-two papers by Campbell and colleagues.<sup>18</sup> This literature broadly, and Campbell quite specifically, makes three selectionist arguments: (1) Our visual and cognitive capabilities have evolved in a manner that assures that we as human beings perceive and mentally process the world around us accurately—otherwise we would not have survived a dangerous and changing world; (2) The plethora of scientific ideas abounding in a socially constructed scientific community are selectively winnowed out and eventually cohere (following hermeneuticists’ coherence theory<sup>19</sup>) such that the community evolves toward holding the most fruitful theories; and (3) The dominant and/or coherent theories held by a scientific community become fruitful (defined as successful and/or instrumentally reliable) as they are selectively and successively adapted to more closely fit with real world entities. Campbell’s conclusion is unmistakable—that selectionist (trial-and-error) learning, is the best explanation for the evolution, if not progression, of human thought and more specifically, the progression of scientific explanation. His attention in 1974 focuses mostly on showing just how pervasive is the infusion of selectionist theory into writing about creative thought, perception, and scientific explanation. But as Campbell’s development of selectionist evolutionary epistemology evolves the four dilemmas emerge. I begin with a short review of how

<sup>15</sup> In Section 4 you will see that successive elimination of inductions is essentially the same as selective evolutionary epistemology.

<sup>16</sup> For a recent review of the anti-realist arguments, see Wright (1997). Despite the review, Wright holds to a “very narrow and guarded Realism” (1997, p. viii), though he does recognize that anti-realism may apply in some circumstances. Suppe (1989) and Blackburn (1993) also suggest a somewhat qualified “quasi-realism.” Another review of realist and anti-realist arguments is Cohen, Hilpinen, and Renzong (1996).

<sup>17</sup> Campbell prefers “*selectionist evolutionary epistemology*” so as to emphasize his favorite thing in the world, blind-variation-and-selective-retention. He emphasizes that this process underlies all inductive knowledge, increases in knowledge, and all increases in the fit of systems to their environments (1974b). Other authors such as Rescher (1987) place less emphasis on the “blind” aspect; some use evolutionary theory only to explain the development of the brain and biological bases of cognitive processes (Bradie 1986); Lorenz (1941) uses evolutionary theory to explain the biological basis of conceptual

structures and categories à la Kant; Hahlweg (1989) and Callebaut (1987) and many others set language up as the genotype with scientists playing the role of phenotypes; Hooker (1995, p. 4) now embeds his *evolutionary naturalized realism* in the framework of “...dynamic nonlinear self-organizing complex adaptive systems,” that is, complexity theory (Prigogine and Stengers 1984, Nicolis and Prigogine 1989, Cowan, Pines, and Meltzer 1994, Belew and Mitchell, 1996, Arthur, Durlauf, and Lane 1997).

<sup>18</sup> The literature includes a number of edited volumes (Greenberg and Tobach 1984, 1987, 1988, 1990; Callebaut and Pinztes 1987, Radnitzky and Bartley 1987, Fuller, et al. 1989, Hahlweg and Hooker 1989, Maxwell and Savage 1989, Rescher 1990), some singly authored books (Ruse 1986, Hooker 1987, and Stich 1990, and numerous articles including Campbell 1959, 1960, 1965, 1974a,b; 1979, 1985, 1986a,b; 1987, 1988a,b; 1989a,b; 1990a,b; 1991, 1994, 1995, Holzner, Campbell, and Shahidullah 1985, Campbell and Paller, 1989, Paller and Campbell 1989).

<sup>19</sup> In coherence theory the truth of an argument is a function of how well it coheres with arguments proposed by others. But hermeneuticists agree that such a process does allow them to know the true meaning of a text beyond a shadow of a doubt.

evolutionary epistemology deals with the dynamics of science. Then, in the following section I show how the dilemmas resolve.

#### A. EPISTEMOLOGICAL DYNAMICS

Halweg and Hooker (1989, pp. 43–44) offer an insightful summary of the arguments in favor of the centrality of selectionist epistemology to epistemological dynamics:

From Lorenz [1941] we take the fundamental importance of understanding the evolutionary history of an organism, capacity, or function for understanding its nature and dynamics. We also take the conclusion that an evolutionary history of cognition supports a general epistemological fallibilism, indeed, a complex fallibilism that is “penetrable,” one whose structure can be theorized (fallibly), investigated and perhaps improved upon. From Piaget [1950] we take the importance of understanding all living processes in terms of the dynamics of open-ended regulatory systems, and the basic idea that psychogenesis is an extension of embryogenesis in this sense. Popper [1972] taught us the importance of reversing the traditional priority between the questions “What is knowledge?” and “How does knowledge progress?”, and the methodological incision of fallibilism. From Toulmin [1972] we take the importance for any evolutionary theory of science of recognizing its historical and social dimensions, and the systematic importance of methods in relations to theories. And from Campbell [1974a,b, 1990b] we take the fundamental role of processes of variation and selective retention to evolutionary development, in particular the power of nested hierarchies of such processes for regulatory systems development, and the importance of recognizing social context in their functioning. It has become evident that evolutionary epistemology sheds fresh light on many areas of traditional philosophy.

Campbell and Paller (1989, pp. 232–233) say that “for the epistemologist of scientific belief, the design puzzle is the presumed fit between belief and the invisible [Realm 3] world to which such belief refers.” They line up with Bhaskar (1975/1997) in noting that since “scientific beliefs are the property and product of a social system...[selectionist] epistemology must include specification of social processes that would plausibly lead to the substitution of more valid belief” (Campbell and Paller 1989, p. 233). Their sociological aspect is similar to Bhaskar’s sociology of knowledge component in his transcendental idealism. The fallibilist sociology of knowledge process leads in an approximationist convergent fashion toward a more probable belief in the truth of explanations about intransitive entities—whether Realm 1, 2, or 3. Halweg proposes theories as maps that guide action, saying, “we select maps on the basis of their capacity to guide us to our destination. Likewise we choose to employ theories that can serve as guides to action. In doing so we indirectly select for theories that depict the genuine invariant relationships holding in the world” (1989, pp. 70–71; his italics). His view could look instrumental, but he emphasizes that picking out theories as guides to action is tantamount to indirectly selecting true theories.

Hooker (1989) develops an *evolutionary naturalism epistemology* where knowledge is conceived of as a “a primary factor in the coordination of our responses to

our environment (including now both our internal environment and the guiding of our search for more knowledge)” (p. 108). In this he is followed by Plotkin (1993) who sees the human brain and its cognitive processing capability as the primary evolutionary adaptation through which the human species now copes with an increasingly rapidly changing environment. In this respect the evolution of science is virtually one and the same with the evolution of the human brain, its cognitive processing, and the human species’ adaptive capabilities. Hooker distinguishes between a horizontal “convergent” evolution of knowledge and a vertical “punctuated” form. Thus:

Theories regulate the development of practices (technologies) and data structures (facts), and methods regulate the development of theories. Methods, theories, and technologies may all be refined and extended; this [horizontal evolution of knowledge] is the “normal” situation. They may also change in more radical or revolutionary ways [vertical evolution of knowledge], thereby...forcing it [theoretical development] to retreat to less committed...assumptions. The key to understanding scientific development is the process of ascending these theoretical and methodological hierarchies and the multiple ways in which normal science may pave the way for this. (1989, p. 109)

Hooker sees science as evolving in both convergent and punctuated ways. Popper (1972) views science as two evolutionary trees growing in the same scientific forest and at the same time. One tree, like Hooker’s horizontal evolution, converges toward optimal designs “within the line” of speciation or specialization toward a specific niche—it shows more and more branches in reflecting the growth of *applied* knowledge resting on the growth of tools and instruments in ever more applied specialized and differentiated niches. The other tree, reflecting the growth of *pure knowledge* or basic research, shows a tendency toward increasing integration, fewer theories, and thus fewer and fewer major branches. Rather than an “either-or” evolution of horizontal (convergent) or vertical (punctuated) evolution, Popper sees it as simultaneous evolution toward many applied branches and fewer integrative theory branches. Taken together we have *convergent*, *punctuated*, and *integrative* evolutions of science.

To summarize into Campbell’s tripartite framework, a selectionist evolutionary epistemology has replaced the historical relativism of Kuhn et al. for the purpose of framing a dynamic epistemology. **First**, much of the literature from Lorenz forward has focused on the selectionist evolution of the human brain, our cognitive capabilities, and our visual senses (Campbell 1988b), concluding that these capabilities do indeed give us accurate information about the world we live in. **Second**, Campbell (1986b, 1988a,b, 1989b, 1991, 1995) draws on the hermeneuticists’ coherence theory in a selectionist fashion to argue that over time members of a scientific community (as a tribe) attach increased scientific validity to an entity as the meanings given to that entity increasingly cohere across members. This process is based on hermeneuticists’ use of coherence theory to attach meaning to terms discovered in archaic religious texts. Campbell draws on the hermeneuticists’ “validity-seeking” principles, such as the *hermeneutic circle* of “part-whole iterating,”

*omnifallibilist trust, pattern matching, increasing correspondence with increasing scope, partial proximal revision, fallibilist privileging of observations and core, and the principle of charity* (Campbell's use of hermeneutics is discussed more fully in Campbell (1991) and also by Hendrickx—Chapter ?? in this volume). This a version of the social constructionist process of knowledge validation that defines Bhaskar's transcendental idealism and sociology of knowledge components in his scientific realist account. The coherentist approach selectively winnows out the worst of the theories and thus approaches a more probable truth. If Campbell stopped here I would place him only in the semantic relativist camp—but he does not.

**Third**, Campbell (1988b, 1991), Bhaskar (1975/1997), Hahlweg and Hooker (1989), AHW (1994), and others add the scientific realist component to part two, thereby producing an ontologically strong dynamic epistemology. In this view the coherence process within a scientific community continually develops in the context of selectionist testing for ontological validity. The socially constructed coherence enhanced theories of a scientific community are tested against an objective reality, with a winnowing out of the less ontologically correct theoretical entities. This process, consistent with the strong version of scientific realism proposed by de Regt (1994), does not guarantee "Truth," but it does move science in the direction of increased verisimilitude.<sup>20</sup>

## B. RESOLVING THE DILEMMAS

**The 1<sup>st</sup> and 2<sup>nd</sup>.** In the final section of his 1974 paper Campbell says:

...[T]he goal of objectivity in science is a noble one, and dearly to be cherished. It is in true worship of this goal that we remind ourselves that our current views of reality are partial and imperfect. We recoil at a view of science which recommends we give up the search for ultimate truth and settle for practical computational recipes making no pretense at truly describing [and explaining] a real world. Thus our sentiment is to reject pragmatism, utilitarian nominalism, utilitarian subjectivism, utilitarian conventionalism, or instrumentalism, in favor of a critical hypothetical realism. (1974b, p. 447; italics)

Campbell faces the dilemma that selectionist epistemology appears to favor pragmatism, instrumentalism, and classical naïve realism when, as the above quote indicates, he recoils at that possibility, preferring "ultimate truth" instead. The instrumental, classical empiricist view of science, dating back to Comtean positivism, defines science as focusing on predictions limited to observable (Realm 1) terms, such as "A falling rock will accelerate," or "A large firm will have more hierarchical layers showing on its organization chart." This is a problem since scientific explanation invariably includes Realms 2 or 3 entities

(terms). As a result of this dilemma, selectionist epistemology has within itself a continuance of the long-running debate about how to resolve the fundamental philosophical problem—how to conduct truth-tests in Realms 2 and 3?

Previously I demonstrate that: (1) Most present-day philosophers of science adopt scientific realism as a credible replacement of positivism and its goal of an objectivist science; (2) Scientific realism has withstood attacks by van Fraassen and Laudan; and (3) There is a credible epistemologically sound argument in favor of a *fallibilist* scientific realism based on the combined works of Bhaskar (1975/1997), Aronson, Harré, and Way (1994), Derksen (1994), and de Regt (1994), among many others. Campbell's first dilemma disappears because scientific realism offers an objectivist alternative to positivism while still retaining terms and entities in Realms 1, 2, and 3.

In this literature and in Campbell's epistemology, fallibilism may result from three causes: Using AHW's diagram, (1) we may be some distance from the origin on the "dotted line" toward truth in the sense that our theory consists of the wrong terms and logic; (2) we may have too much "metaphysicality" in the terms and entities of our theory for solid truth-tests; and (3) we may be closer to stage 2 (socially constructed idealism) than stage 3 (empirically based realism) in Bhaskar's diagram. Thus, at any given time we may not know quite which source of fallibilism is operating to tarnish our truth-test. Since the dynamics of selectionist evolutionary epistemology "select" to lessen all three kinds of fallibility by winnowing out the most obvious elements of fallibilism, there is slow incremental progress toward increased verisimilitude.

Given that the search for truth at any given time is independent from the metaphysicality of terms and entities, there is nothing in selectionist winnowing that inexorably pushes toward operationalism or naïve realism. Fallibilism could be as much due to operational measures that are overly narrow in meaning, too unstable because of changing instruments, or have poor reliability and validity, as it might be to too many metaphysical entities and lack of solid measures. The crux of the matter hinges on the *quest for truth* on the one hand and the *veil of perception* on the other, as depicted earlier in Figure 2. AHW set the *quest* and the *veil* independent of each other—each being an independent cause of lower verisimilitude. The *quest* is now defined in terms of the "new" convergent realism, probable knowledge, the rationality of existential scientific beliefs, fallibilist eliminative inductions, and the risk that the prolonged existence of Realm 3 terms falsely postulated to be real is negligible. The *veil* moves independently of the *quest*, depending on the development of detection instruments or methods such that the *quest* is not held hostage by limitations that human sensory capacities might place on the where the *veil* might be set at any given time. The scientific realists' separation of the *quest* from the *veil* is important because this negates Campbell's concern that selectionist epistemology, as a fallibilist process of searching for truth,

<sup>20</sup> For a counter view see Stich (1990), who argues for pragmatism over selectionist explanation.

steers science toward Realm 1 terms. It does not. Whether to believe that Realm 3 terms are or are not real is now independent of the status of the quest for truth. The dilemma is resolved.

**The 3<sup>rd</sup> and 4<sup>th</sup>.** An *objectivist inductively plausible convergent fallibilist scientific realism* also resolves Campbell's third and fourth dilemmas. Popper would add his term, *falsificationist*, to this string of adjectives. Scientific realism is an objectivist postpositivist epistemology that backs its way toward more probably true theories by incrementally winnowing out the worst of the theories, terms, and entities at any given time. Selective evolutionary epistemology is a well developed literature that provides the mechanics for how convergent scientific realism changes the beliefs and theories held by scientists. Objective reality plays the role of ecological forces in evolutionary theory. The selection process imposed by the objective ecology provides an ever present context in which theories, conceptions, interpretations, social constructions, terms, and imagined entities all compete for survival.

Surviving theories are not of guaranteed Truth. The search for Truth with a capital T died along with positivism. Surviving theories are more fruitful, presumably, because they have more verisimilitude or more instrumental reliability. Thus the theory, "the sun rises because it goes around the earth," is very reliable but we now know it is false. The theory, "earthquake swarms precede volcanic eruptions," has high verisimilitude but not reliability. A theory could be successful, that is, used frequently, for either reason. As Laudan (1981) points out, in the context of instrumental reliability, success does not guarantee truth. However, the relation of success with verisimilitude may be a function of a science's life-cycle. If Verisimilitude and Reliability are set up as in an equation, realists would expect that Success would initially vary directly mostly with R. But that as R asymptotes toward 100% predictability, S would vary more and more with V. If on the other hand R does not asymptote out but continues low, S might vary randomly with R but more directly with V. Two of the many reasons why this might be so are: (1) As fields of inquiry widen, early high R theories are found wanting—for 10<sup>th</sup> century farmers it is irrelevant whether a theory about the sun rising is true or not, but for launching probes to Jupiter in the 20<sup>th</sup> century it makes a tremendous difference; and (2) drawing on de Regt (1994), it is irrational for scientists to knowingly accept a false theory, or to ignore the verisimilitude of a theory, and despite continuous calls for instrumentalism or pragmatism over the years most scientists still insist on thinking of theories as true or false, so the question of verisimilitude never goes away—and it is equally irrational for philosophers to ignore the rationality of scientists. Note that in the above I did not say S caused V or that V caused S—just that they would vary directly.

Scientific realists conclude, therefore, that surviving theories have higher verisimilitude than those that do not. This view of the dynamic process does not deny the existence of interpreted theory terms or socially constructed terms. Nor does it even deny the possibility that disciplinary matrices or paradigms might be incommensurable. Neither does it require that social scientists give up their favorite relativist paradigm, since all of these fit into Bhaskar's transcendental idealism, which is stage 2 on the way to an objectivist empirically tested transcendental realism. So, unless scientists are willing to arrest scientific progress at stage 2, by denying that some explanations of sunlight, falling rocks, earthquakes, quasars, disease, behavior, and organizational knowledge and learning have more verisimilitude than others, Campbell's epistemology, built solidly on ontological realism resolves the third and fourth dilemmas. Epistemology is now at a point where an objectivist dynamic view of science exists, as does an objectivist epistemology that includes transcendental idealism and the many relativist paradigms.

## V. CAMPBELLIAN REALIST ORGANIZATION SCIENCE

There could be as many different uses of the *paradigm* word in organization science as there are in Kuhn's 1962 book. Some authors worry deeply about the right or wrong paradigm, how many there are, about positivism, relativism, subjectivity and reflexivity, about incommensurability, and perhaps whether there is much real truth to what is taught in business schools and practiced by consultants. A few authors argue about it vociferously in the journals. And most organization researchers, like most physicists, go blissfully about their empirical work without worrying about "all that philosophical stuff"—pick a theory, propose an hypothesis, find a data set, find some results at  $p < .05$ , get published, get tenure, get promoted. Pfeffer (1993) says that the result of all this is a low status science busily replicating itself with little outside influence or attention.

Much of this miasma is archaic and misinformed. Organization scientists are not positivists because they do not believe in verification and covering laws but do believe in cause and metaphysical terms. Nor are they strong form relativists, because they do not believe in paradigm incommensurability—otherwise how could one author write about all paradigms in one textbook, and worse, think that incommensurable paradigms could be explained to students? If the paradigm war is archaic, misinformed, and vapid anyway, what added benefit does Campbell offer?

*Campbellian realism* is critical because elements of positivism and relativism, in fact, remain. Thus, core aspects of the underlying epistemological debate also continue. Many theory terms pertaining to organizational behavior still are in Realms 2 or 3, as this hypothesis suggests:

Firms with configurations of competence enhancing HR system attributes that are unique, causally ambiguous, and synergistic will have sustained competitive advantage over firms that have HR system configurations that are typical, causally determinate, and nonsynergistic

(Lado and Wilson 1994, p 718; my underlining).<sup>21</sup>

Though the dotted underlined terms probably are in Realm 2, it seems likely that the underlined terms may never leave Realm 3. Some would argue that even “firms” is a Realm 2 entity. Since metaphysical terms remain, the positivists’ fundamental concern over how to ascertain truthlikeness also remains. The hypothesis also consists of three lines of text, with the meaning of each word subject to individual interpretation and collective social construction, so these aspects of semantic relativism also remain.

Boiled down, the debate between objectivists and social constructionists surely continues and could still work to produce a multiparadigm organization science continuing in low status. With the debate crystallized to its essence, Campbell’s epistemology offers a solution that folds into a single epistemology (1) metaphysical terms, (2) objectivist empirical investigation, (3) recognition of socially constructed meanings of terms, and (4) a dynamic process by which a multiparadigm discipline might reduce to fewer but more significant theories. Surely this is a message organization science needs at this stage in its life-cycle.

The resolution of the Campbellian dilemmas defines a *critical, hypothetical, corrigible, scientific realist selectionist evolutionary* epistemology characterized as follows:

1. A scientific realist postpositivist epistemology that maintains the goal of objectivity in science without excluding metaphysical terms and entities.
2. A selectionist evolutionary epistemology governing the winnowing out of less probable theories, terms, and beliefs in the search for increased verisimilitude may do so without the danger of systematically replacing metaphysical terms with operationalisms.
3. A postrelativist epistemology that incorporates the dynamics of science without abandoning the goal of objectivity.
4. An objectivist selectionist evolutionary epistemology that includes as part of its path toward increased verisimilitude the inclusion of, but also the winnowing out of the more fallible, individual interpretations and social constructions of the meanings of theory terms comprising theories purporting to explain an objective external reality.

As I have demonstrated at least in part, the epistemological directions espoused by Campbellian realism have strong foundations and wide support in the scientific realist and evolutionary epistemology communities. While philosophers never seem to agree exactly on anything, nevertheless broad consensus does exist that these tenets reflect what is best about current philosophy. As the debate about organization science

epistemology goes forward, the points listed in Table 7 should be seriously considered as central elements of the field. These points combine key epistemological tenets developed by Campbell, de Regt, and Aronson, Harré, and Way.

>>> **Insert Table 7 about here** <<<

I would be remiss not to make a special point of the role of experiments in Campbellian realism. Experiments and what Bhaskar terms “contrived invariances” play a central role in scientific realism, as is evident in the elements of Table 7 attributed to de Regt and AHW. Campbell, needless to say, has advocated quasi-experiments for fields such as organization science for years (Cook and Campbell 1979). The literature following from this work is described in more detail by Evans (chapter in this volume). While I do not have space to develop the ideas of the semantic conception theorists (Beth 1961, Suppes 1962, Suppe 1989, Lloyd 1988, Thompson 1989), this line of epistemology, as a third ontologically strong postpositivism, places models at the center of science. Though organization scientists have been remiss by not drawing on experimental or quasi-experimental research designs, the development of microcomputers has made computational models and computational experimental methods more accessible. Coupled with the semantic conception’s positioning of models, it is now possible for organization science to become much more of an experimental science. I outline this approach in McKelvey 1998a,b,c)

A significant caveat is relevant. As I have argued elsewhere (McKelvey 1997), organization science is *quasi-natural*. Organizational phenomena appear to result from both human intentionality and naturally emergent behavior and may have varying amounts of the reflexive component that Perrow (1994) emphasizes. The field, as Hannan and Freeman (1977) observed long ago, has made more progress in describing and understanding intentional managerial behavior than it has in developing the science of how idiosyncratic process events and other microstate levels of behavior interact to produce emergent aspects of organization structure, function, and process. Because of this imbalance, Campbellian realism serves the interests of organization scientists attempting to develop the natural side of organization science more than it might for those worried about intentionality and reflexiveness.

## VI. CONCLUSION

Now that the excesses of positivism and historical relativism have been abandoned, the discourse reduces to the age-old debate among objectivists and subjectivists, which Natanson (1963) observes goes back to Plato and Aristotle. Much of postpositivist postrelativist philosophy of science has evolved as scientific realism and evolutionary epistemology. Campbell has built on these developments to create a *Campbellian realism* particularly relevant to organization science.

In this chapter I first review some of the reasons why positivism and relativism were abandoned by philosophers.

<sup>21</sup> If one applied the Copenhagen Interpretation (Bitbol 1996), which holds that a particle such as an electron is metaphysical because the act of detection alters its state—the Heisenberg Uncertainty Principle—one might conclude that all terms in this hypothesis are metaphysical since it is well known that the act of measuring in firms sensitizes them and thus could (it is an uncertainty) alter their state.

I then argue that the four Campbellian dilemmas bringing together objectivism, metaphysical entities, relativism, and science dynamics are resolved now that the scientific realist and evolutionary epistemology literatures are more fully developed. Given that Campbellian realism is now on a strong footing, its implications for organization science are more compelling.

In Table 7 I combine the message of the four resolved dilemmas with key elements of the realism set forth by de Regt (1994) and Aronson, Harré, and Way (1994). Taken together these elements suggest key tenets of a new organization science. These tenets allow organization science to get past the current paradigm debates in its literature. Some of this debate exists only because authors are philosophically misinformed and out-of-date. The debate over the verisimilitude of more specific paradigms like contingency theory, organizational economics, population ecology, institutional theory, and the like (Donaldson 1995), continues largely because the scientific standards thought to guide organization science are so vague and watery that corroboration or refutation of one or another theory remains obscure. Table 7 sets the scientific “bar” high enough to make the research process more telling.

Besides being philosophically uninformed, much of the low quality/low status of organization science could simply be due to the fact that organization science is more than two centuries younger than physics and economics. And some of it seems due to the difficulty of applying normal science methods to the study of intentional behavior, some of which may reflexively respond to the research process itself, as Perrow (1994) observes. Nevertheless, it appears that many organizational phenomena may be fruitfully studied under the guidance of the tenets suggested in Table 7. If organization scientists were to follow these tenets of Campbellian realism—really present-day science—there is some reason to hope that theory proliferation would diminish and the status and influence of organization science, as viewed by outsiders, would rise.

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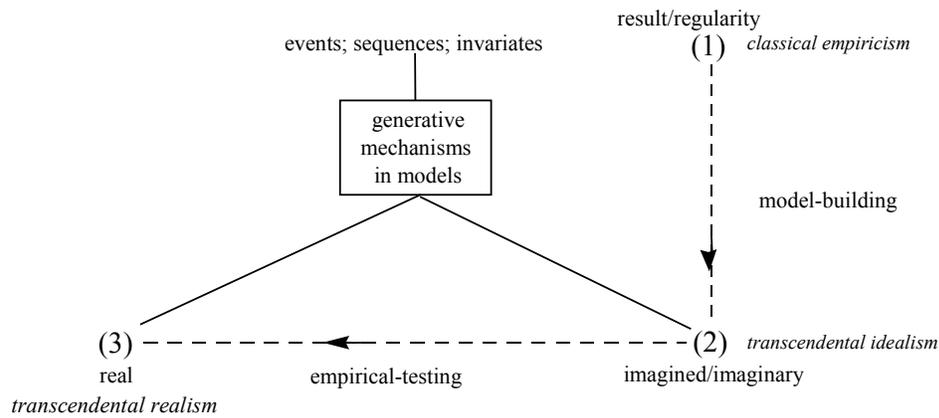
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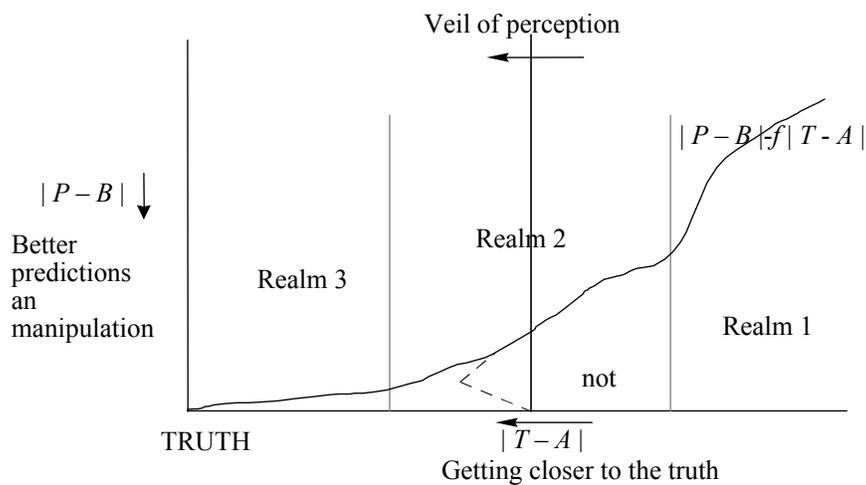
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**Figure 1 Bhaskar's Depiction of the Logic of Scientific Discovery** †



† Graphically reconstructed from Diagram 3.1 in Bhaskar (1975/97, p. 145)

**Figure 2 AHW's Graphical Representation of Convergent Realism** †



† Graphically recreated from Figure 9.1 in Aronson, Harré, and Way (1994, p. 195).

**Table 1 Basic Tenets of Organization Science Remaining from Positivism<sup>†</sup>**

1. The truth or falsity of a statement cannot be determined solely by recourse to axiomatic formalized mathematical or logical statements without reference to empirical reality.
2. Analytic (logic) and synthetic (empirical fact) statements are both essential elements of any scientific statement, though not always jointly present.
3. Theory and observation terms are not strictly separate; they may shift from one categorization to the other or may satisfy both categorizations simultaneously.
4. Theory terms do have antecedent meaning independent of observation terms.
5. Theoretical language is invariably connected to observation language through the use of auxiliary statements and theories, lying outside the scope of the theory in question, which may or may not be well developed or even stated.
6. The meaning of theoretical terms may be defined by recourse to analogies or iconic models.
7. Procedures for connecting theories with phenomena must specify causal sequence and experimental connections; experimental connections must include all methodological details.
8. Theories may or may not be axiomatizable or formalizable.
9. It is meaningless to attempt to derive formalized syntactical statements from axioms devoid of semantic interpretation.
10. Formalization is an increasingly desirable element of organization science, approaching the state of being necessary though not sufficient.
11. Static semantic interpretation of formalized syntactical statements is not sufficient, given the dynamic nature of scientific inquiry.
12. The "lawlike" components of theories contain statements in the form of generalized counterfactual conditionals, "If A, then B," and theories gain in importance as they become more generalizable.
13. Lawlike statements must have empirical reference otherwise they are tautologies.
14. Lawlike statements must have "nomic" necessity, meaning that the statement or finding that "If A then B" is interesting only if a theory purports to explain the relationship between A and B; that is, "If A then B" cannot be the result of an accident.
15. The theory purporting to explain "If A then B" must be a systematically related set of statements embedded in a broader set of theoretical discourse interesting to organization scientists, which is to say, empirical findings not carefully connected to lawlike statements are outside scientific discourse.
16. Some number of the statements comprising a theory must consist of lawlike generalizations.
17. Theoretical statements must be of a form that is empirically testable.

<sup>†</sup> The first eleven tenets come from Suppe's summary (1977, p. 117); the remaining six come from Hunt (1991, p. 107–117).

**Table 2 Boyd's Elements of Scientific Realism<sup>†</sup>**

1. "Theoretical terms" in scientific theories (i.e., nonobservational terms) should be thought of as putatively referring [to phenomena] expressions; scientific theories should be interpreted "realistically."
2. Scientific theories, interpreted realistically, are confirmable *and in fact often confirmed* as approximately true by ordinary scientific evidence interpreted in accordance with ordinary methodological standards.
3. The historical progress of mature sciences is largely a matter of successively more accurate approximations to the truth about both observable and unobservable phenomena. Later theories typically build upon the (observational and theoretical) knowledge embodied in previous theories.
4. The reality which scientific theories describe is largely independent of our thoughts or theoretical comments.

<sup>†</sup> Quoted from Boyd 1983, p. 45.

**Table 3**      **Laudan's Arguments Against Scientific Realism** <sup>†</sup>

1. There is no historical evidence showing that whether a theory's central terms "refer" to real phenomena or not is related to success.
2. The notion of "approximate truth" is too vague to permit one to judge whether its laws would be empirically successful or not.
3. Realists have no explanation for why many theories that lack approximate truth and real world reference are nevertheless successful—quantum theory being the classic example.
4. Early "approximate truths" in early theories often not preserved in later theories.
5. The realist argument based on reference and approximation as the basis of truth ignore the anti-realist's main objection—that explanatory success corresponds to truth.
6. The standard of approximative improvement is irrelevant—a theory should not have to explain how or why earlier rivals worked.
7. If an early theory is false, it is nonsensical to expect a later improvement based on the earlier falsity to be an improvement on truth.
8. Realists have not demonstrated that other nonrealist theories are inadequate to explain the success of a science.

<sup>†</sup> Paraphrased from Laudan 1981.

**Table 4**      **Van Fraassen's Constructive Empiricism** <sup>†</sup>

1. *Science aims to give us theories which are empirically adequate: and acceptance of a theory involves as belief only that it is empirically adequate.... I shall call it constructive empiricism.... [A] theory is empirically adequate if what it says about observable things and events in this world is true.... [A] little more precisely: such a theory has at least one model that all the actual phenomena fit inside.... (p. 12) [It] concerns actual phenomena: what does happen, and not, what would happen under different circumstances. (p. 60)*
2. The syntactic picture of a theory identifies it with a body of theorems.... This should be contrasted with the alternative of presenting a theory in the first instance by identifying a class of structures as its models.... The models occupy centre stage. (p. 44)
3. To present a theory is to specify a family of structures, its *models*, and secondly, to specify certain parts of those models (the empirical *substructures*) as candidates for the direct representation of observable phenomena. The structures which can be described in experimental and measurement reports we can call *appearances*: the theory is empirically adequate if it has some model such that all appearances are isomorphic to empirical substructures of that model. (p. 64)
4. With this new [model centered, semantic] picture of theories in mind, we can distinguish between two epistemic attitudes we can take up toward a theory. We can assert it to be true (i.e. to have a model which is a faithful replica, in all detail, of our world), and call for belief; or we can simply assert its empirical adequacy, calling for acceptance as such. In either case we stick our necks out: empirical adequacy goes far beyond what we can know at any given time. (All the results of measurement are not in; they will never all be in; and in any case, we won't measure everything that can be measured.) Nevertheless there is a difference: the assertion of empirical adequacy is a great deal weaker than the assertion of truth, and the restraint to acceptance delivers us from metaphysics. (pp. 68–69)
5. It is philosophers, not scientists (as such), who are realists or empiricists, for the difference in views is not about what exists but about what science is. (1985, p. 255, n6)

<sup>†</sup> Quotes all from van Fraassen 1980 unless otherwise specified; his italics.

**Table 5** De Regt's Strong Argument for Scientific Realism<sup>†</sup>

1. A plausible distinction exists between Realm 1 (observable) and Realm 3 (unobservable) terms, as viewed by scientists.
2. This distinction is epistemologically relevant. Realm 3 terms (and the explanations constructed from them) are, thus, limited to more cautious claims.
3. The true/false dichotomy is replaced by "truthlikeness" (Popper's verisimilitude), and degrees or probabilities of truthlikeness. "Probabilism is the 'new' paradigm."
4. Current scientific theories are considered instrumentally reliable in that they incorporate highly probable knowledge concerning Realm 1 terms.
5. These theories are the result of incremental inductions eliminating theories with lower probability truthlikeness.
6. Many of the highly probable theories remaining postulate and depend upon the existence of Realm 3 terms.
7. Underdetermination remains a risk since there are infinitely many ontologically interesting probably wrong but empirically equivalent (at any given time) alternative theories (analogous to few equations, many unknowns).
8. The chance that the postulated Realm 3 terms do not exist (are not real—and thus the theory/explanation is based on terms whose truth value can never be ascertained) is present but negligible.
9. "Therefore, inductive arguments in science lead to probable knowledge concerning unobservables; one is epistemologically warranted to *tentatively* (at any given time) believe in the existence of the specified unobservables; scientific realism is *more plausible* than [van Fraassen's] constructive empiricism" (de Regt's italics).

<sup>†</sup> Liberally paraphrased, with some quotes, from de Regt (1994, p. 284; underlining added)

**Table 6** Aronson, Harré, and Way's Plausibility Thesis<sup>†</sup>

1. "A theory...[must consist of law-like statements] capable of yielding more or less correct predictions and retrodictions, the familiar criterion of 'experimental<sup>‡</sup> adequacy'." (p. 191)
2. The law-like statements of a theory must also be "based on a model...which expresses the common ontology accepted by the community" (p. 191) which is to say, the model must relatively accurately represent that portion of the phenomena defined by the scope of the theory, that is ontological adequacy.
3. "...[T]aken together, increasing experimental adequacy and ontological adequacy [which increase plausibility] are inductive grounds for a claim of increasing verisimilitude...." (p. 191)
4. "The content of a theory consists of a pair of models..., that is, both the descriptive [ontological adequacy] and the explanatory [experimental adequacy] model" (p. 193) should represent the phenomena. Ideally, as a science progresses, the pair of models would merge into one model.
5. "...[T]he verisimilitude of a theory is nothing other than its content: that is, of the model or models of which that content consists." (p. 193)
6. The juxtaposition of both experimental and ontological adequacy minimizes underdetermination.
7. "The key to our defense of our revised form of convergent realism is the idea that realism can be open to test by experimental considerations." (p. 194)
8. "When it comes to gathering evidence for our beliefs, *the epistemological situation remains the same for observables and unobservables alike*, no matter whether we are dealing with observables [Realm 1], possible observables [Realm 2] or unobservables [Realm 3]. (p. 194)
9. "...[T]he increase in accuracy of our predictions and measurements is a function of how well the models upon which the theories we use to make these predictions and measurements depict nature." (p. 194)
10. "...[S]cientific progress serves as a measure of the extent our theories are getting closer to the truth." (p. 194)
11. "...[C]onvergent realism is not necessarily committed to using verisimilitude to *explain* scientific progress, it is committed to the view that there is a functional *relationship* between the two, that as our theories are getting closer to the truth we are reducing the error of our predictions and measurements *and vice versa*." (p. 194–195)
12. "...[T]he relationship between theory and prediction, on the one hand, and between nature and the way it behaves, on the other, remains the same as we move from observables to possible observables to unobservables in principle." (p. 196)

<sup>†</sup> Paraphrased and quoted from Aronson, Harré and Way (1994).

<sup>‡</sup> As explained in endnote #13, I have substituted "experimental" instead of "empirical" to avoid confusion.

**Table 7**                      **Suggested Elements of an Organization Science Epistemology**

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**Organizations science:**

1. Is an objectivist science that includes terms in all three Realms.
2. Recognizes that though the semantic meanings of all terms are subject to interpretation and social construction by individuals and the scientific community, this semantic relativism does not thwart the eventual goal of an objective though fallible search for increased verisimilitude.
3. Includes a selectionist evolutionary process of knowledge development that systematically winnows out the more fallible theories, terms, and entities over time.
4. Does not, as a result of its selectionist process, systematically favor either operational or metaphysical terms.
5. Accepts the principle that the true/false dichotomy is replaced by verisimilitude and degrees or probabilities of truthlikeness.<sup>†</sup>
6. Includes theories that are eventually the result of fallible incremental inductions eliminating those having less probable verisimilitude.<sup>†</sup>
7. Because knowledge concerning Realm 1 and 2 terms and entities is at best probable, tentative belief in the probable existence and verisimilitude of Realm 3 terms is no less truthlike than the fallible truth associated with theories comprising Reams 1 and 2 terms and entities.
8. Defines theories to consist of law-like statements having predictive elements capable of being tested for experimental adequacy.<sup>‡</sup>
9. Insists that theories be based on (preferably formalized) models representing that portion of phenomena within the scope of the theory and subject to tests for ontological adequacy.<sup>‡</sup>
10. Defines verisimilitude in terms of the content of its models.<sup>‡</sup>
11. Is based on a convergent realism in which there is a functional relationship such that increased verisimilitude serves to reduce the error in measures and predictions and vice versa.<sup>‡</sup>
12. Holds that the relation between (1) theory and prediction; and (2) organizations and how they behave, remains independent of whether terms and entities are in Realms 1, 2, or 3.<sup>‡</sup>

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<sup>†</sup> Based on one of de Regt's (1994) points from Table 5

<sup>‡</sup> Based on one of Aronson, Harré and Way's (1994) points from Table 6.